CAAM 435

Dynamical Systems – Theory and Computation

Spring 2015 Rice University

Lectures and Recitations: Mon – Wed – Fri 2pm, Duncan Hall 1061

Web Site: http://www.caam.rice.edu/~caam435

Instructor: Yuri Dabaghian

email: dabaghian at rice.edu,
phone: (713) 348 6073

Office hours: Duncan Hall 2006, Mon 3-6 pm, Wed and Fri by appointment

Recommended Pre-requisites: CAAM 210 and MATH 212, and (CAAM 335 or MATH 355), and (CAAM 401 or MATH 321)

Course Objective: The CAAM 435 course will provide an overview of Nonlinear Dynamics theory. Our discussions will examine various examples of dynamical systems and provide you with hands-on experience in qualitative and quantitative analytic techniques to better understand dynamical maps and flows; equilibria and stability; integrability and chaotic phenomena; periodic, quasiperiodic and chaotic orbits; Poincaré maps and Smale horseshoes; free, forced and coupled oscillators; the geometry of the dynamics in phase space, bifurcations and catastrophes. We will also discuss applications of dynamical systems theory to physics, neuroscience and biology.

Primary textbooks:

- S. Strogatz, Nonlinear dynamics and chaos : with applications to physics, biology, chemistry, and engineering, Perseus Books, 1994.
- E.M. Izhikevich, Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting. The MIT press, 2007.

Reference Texts:

- D. K. Arrowsmith and C. M. Place, Dynamical Systems: Differential Equations, Maps and Chaotic Behavior, Chapman & Hall, London, 1992.
- E. Ott, Chaos in Dynamical Systems, Cambridge, 1993.
- V. I. Arnold, Ordinary Differential Equations, MIT Press, 1978.
- V. I. Arnold, Mathematical Methods of Classical Mechanics, Springer, 1989.
- V. I. Arnold, Geometrical Methods in the Theory of Ordinary Differential Equations, Springer, 1988.

Grade Policy: 40% exams, 60% problem sets. Students are strongly encouraged to participate in lectures and recitations. Class participation will influence borderline grades and help to improve overall performance.

Exams: Two take-home open-book exams, which must be your individual, unassisted effort, will account for 40% of the final grade (20% each).

Homework assignments: Problem sets will be assigned roughly once a week, due at 7 pm on the specified date. Analytical solutions for all problems are expected. Your submitted write-up must be your own independent work, but you may collaborate on the problems.

Absence Policy: Students are strongly encouraged to attend the class, participate in lectures and active learning activities.

Late Policy: You may turn in two problem sets one class period late. Subsequent late assignments will be penalized 15% each. No two “lates” on one assignment. In exceptional circumstances, please contact the instructor as soon as possible: we adhere to Student Health's `No Note' policy.

Special materials: None

- Students who require additional accommodation please contact the course instructor and Disability Support Services in the Allen Center.